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VEGETATION OF CATCHMENT AND SUBMERGENCE AREA UNDER GOSUNDA IRRIGATION PROJECT, CHITTORGARH (RAJASTHAN)

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ABSTRACT

The present paper deals with the indigenous vegetation of a part of Chittorgarh district (submergence and catchment area under Gosunda Irrigation Project) and the major plant communities in different habitats, including plants frequently occurring in them. A total number of 276 species belonging to 237 genera and 77 families have been recorded.

INTRODUCTION

A perusal of literature concerning vegetation of Rajasthan (Jain, 1972; Sharma 1980) revealed that there is no publication on the flora of Chittorgarh district. The present work, though confined to a small area of the district, is significant since after the completion of the Irrigation Project the area would be badly effected and the original flora will disappear.

The Gosunda Irrigation Project has been proposed on the river Berach near the village Appawas, about 14 km from Chittorgarh on Udaipur road at 352 m above m.s.l. between 74° - 31′ - 30″ east and 24° - 49′ north (Plate-1). The gross catchment area up to the dam site is about 4,66,200 hectares. The catchment is from the two main rivers, the Berach and Wagon. The river Berach originates in Udaipur district and passes through tectonic, undulating plains and hilly tracts in Chittorgarh district. The length of this river in this district is about 87 km and the catchment area is flat and mostly cultivated. Wagon river originates near Bari Sadri, flows in a north-easterly direction for about 57 km and joins Berach near Hoda village in Chittorgarh district. Wagon catchment is fan-shaped and partly hilly covered with vegetation. The gross command area under both main canals and their branches along both the flanks of Berach rirver would be about 16,137 hectares. The project shall involve submergence of 1,973 hectares, of which about 603 hectares is cultivated land, 953 hectares shrub and fallow land and 417 hectares open water.

The climate of this area is semi-arid with an annual rainfall of about 850 mm and mean maximum annual temperature about 32°C. The soils of the catchment and submergence area fall under the broad categories of deep medium black soil, yellowish-brown soil, greyish-brown alluvial soil and hilly soils. These soils are normal in fertility on account of their nitrogenous and phosphatic contents and an excess of potash. No water-lodging problem is expected in the area since water table is at a depth of 12-16 m and drainage is quite good.

The specimens collected during the botanical exploration of the area by the authors are deposited in the herbarium of Arid Zone Circle, Botanical Survey of India, Jodhpur (BSJO).

VEGETATION

The vegetation is xerophytic in character. The floral composition of the catchment and submergence area as per their habitats is given below.

(1) *Hills and hillocks*: Various hills and hillocks belonging to the Aravalli sys-

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tem and consisting of quartzite-schists formation were noted in the area. The important locations are: Sarlai, Hoda, Appawas, Dhirji-ka-Khera, Nahargarh, Bhadesar, etc. Most of these hills are excessively stoney, with bare soil as they are under great biotic and climatic pressure. The characteristic perennial species of such exposed hills are *Acacia leucophloea* (Roxb.) Willd., *Anogeissus pendula* Edgew., *Balanites aegyptiaca* (L.) Del., *Butea monosperma* (Lam.) Taub., *Diospyros montana* Roxb., etc. In the crevices of rocks where some moisture accumulates and on the slopes with better soil formation a mesophytic herbaceous flora mainly dominated by *Urginea indica* (Roxb.) Kunth or by some grasses exists. The other common plants on the exposed hills are: *Actiniopteris radiata* (Sw.) Link, *Adiantum capillus-veneris* L., *A. incisum* Forsk., *Alysicarpus monilifer* (L.) DC., *Biophytum sensitivum* (L.) DC., *Blainvillea acmella* (L.) Philipson, *Borreria articularis* (L. f.) F. N. Will., *B. pusilla* (Wall.) DC., *Cassia pumila* Lam., *Catharanthus pusillus* (Murr.) G. Don, *Elytraria acualis* (L. f.) Lindau, *Enicostema hyssopifolia* (Willd.) Verd., *Euphorbia parviflora* L., *Evolvulus alsinoides* (L.) L., *Glossocardia bosvallea* (L. f.) DC., *Heliotropium marifolium* Retz., *Hybanthus enneaspermus* (L.) Muell., *Leucas nutans* (Roxb.) Spreng., *Lindenbergia indica* (L.) Ktze., *Oldenlandia corymbosa* L., *Orthosiphon pallidus* Royle ex Benth., *Oxalis corniculata* L., *Phyllanthus fraternus* Webster, *P. virgatus* J. C. Forst., *Polygala arvensis* Willd.. *Rostellularia quinqueangularis* (Koen. ex Roxb.) Nees, *Tridax procumbens* L., *Vernonia cinerea* (L.) Less. and grasses like *Melanocenchris jacquemontii* Jaub. & Spach., *Oropetium thomaeum* (L. f.) Trin., *Tragus roxburghii* Panig., etc. A high frequency of perennial species on these hills are in browsed condition (Plate-1).

The 'reserve' forests' on the hills maintained by the Forest department mainly consist of *Anogeissus pendula* Edgew.; the other common associates are *Acacia chundra* (Roxb. ex Rottl.) Willd., *A. leucophloea* (Roxb.) Willd., *Aegle marmelos* (L.) Corr., *Butea monosperma* (Lam.) Taub., *Cassia fistula* L., *Flacourtia indica* (Burm. f.) Merr., *Holoptelea integrifolia* (Roxb.) Planch., *Lannea coromandelica* (Houtt.) Merr., *Mimosa rubicaulis* Lam., *Mitragyna parvifolia* Korth., *Rhus mysurensis* Heyne ex Wt. & Arn., *Tectona grandis* L. f., *Wrightia tinctoria* R. Br., etc. At the foot of the hills, the vegetation is highly disturbed and stunted much branched *Butea monosperma* (Lam.) Taub. has replaced the original crop to a great extent. Since the tree canopy is considerably dense, the shrubs and undershrubs are very poorly represented. The notable species are: *Barleria prionitis* L., *Grewia flavescens* Juss. and *Lantana indica* Roxb. The ground cover is fairly dense during the rainy season. The common species are: *Acanthospermum hispidum* DC., *Achyranthes aspera* L., *Bidens biternata* (Lour.) Merr. & Sherff ex Sherff, *Boerhavia diffusa* L., *Cassia pumila* Lam., *C. tora* L., *Desmodium gangeticum* (L.) DC., *Dipteracanthus patulus* (Jacq.) Nees, *Oplismenus compositus* (L.) P. Beauv., *Pavonia arabica* Hochst. ex Steud., *P. zeylanica* (L.) Cav., *Sclerocarpus africanus* Jacq. ex Murr., *Trichodesma sedgwickianum* Banerj., *Tridax procumbens* L., *Triumfetta rotundifolia* Lam., etc. The notable climbers in these forests are *Ampelocissus latifolia* (Vahl) Planch., *Asparagus racemosus* Willd., *Cayratia trifolia* (L.) Domin., *Dioscorea bulbifera* L., *Rivea hypocrateriformis* (Desr.) Choisy, etc. The altitude does not have any effect on the zonation of annual and perennial vegetation (Plate-2).

The characteristic forest of the submergence and catchment area was noted near Dhaneshwar Mahadeo temple. In this area there is a slow running perennial stream fed

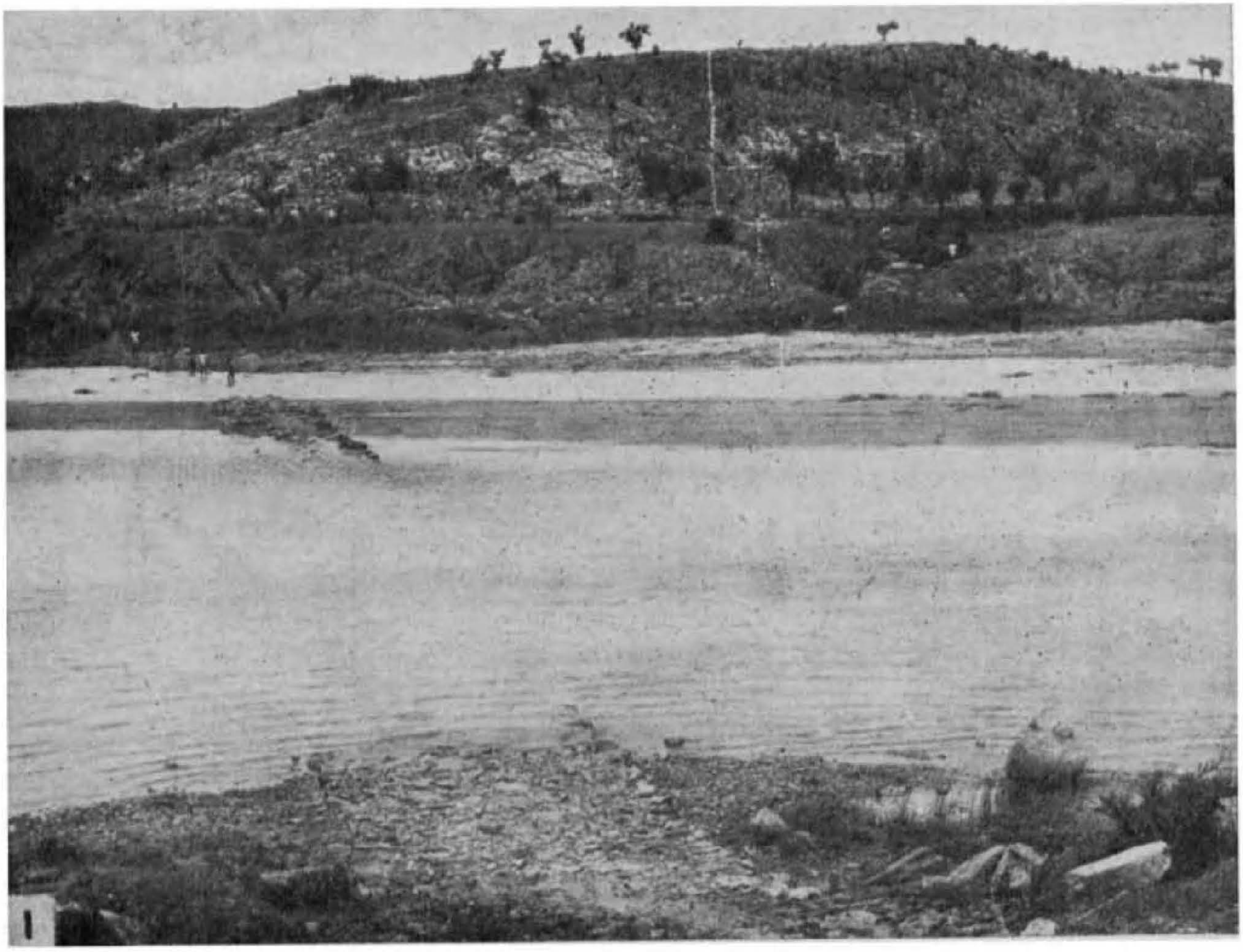

Plate 1 : White line on the hillock indicates the exact location for the construction of Dam on the river Berach near Appawas village. The exposed hillock consists *Acacia leucophloea* (Roxb.) Willd., *Anogeissus pendula* Edgew., *Balanites aegyptiaca* (L.) Del., etc.

by a nearby tank. The characteristic species are: *Bridelia squamosa* (Lam.) Gehrm., *Ficus virens* Ait., *Mangifera indica* L., *Pandanus odoratissimus* L. f., *Polyalthia longifolia* (Sonner.) Thw., *Syzygium cumini* (L.) Skeels, *Tamarindus indica* L., *Terminalia arjuna* (Roxb. ex DC.) Wt. & Arn. and extensive climbers like *Caesalpinia decapetala* (Roth) Alston and *Carissa congesta* Wt. Perhaps these species were planted long ago and now they form a sort of forest near the temple.

(2) *Tectonic and undulating plains*: The area falling outside the range of the hills and cultivated land is tectonic and undulating having a thin layer of soil. It presents a very characteristic dry deciduous scrub vegetation containing sparse and discontinuous tree layer with plenty of vacant space between them. The most common tree species are: *Acacia chundra* (Roxb.) Willd., *A. leucophloea* (Roxb.) Willd., *A. nilotica* (L.) Del., *Diospyros montana* Roxb., *Madhuca longifolia* (Koenig) Mac Bride var. *latifolia* (Roxb.) Cheval., *Phoenix sylvestris* (L.) Roxb., *Prosopis cineraria* (L.) Druce, etc. It is interesting to note that the progressive regeneration of most of the trees, both by seeds and coppice, is negligible due to great biotic pressure (Plate-3). The following formations were noted at different places:

(i) *Acacia leucophloea - Butea monosperma - Phoenix sylvestris.*

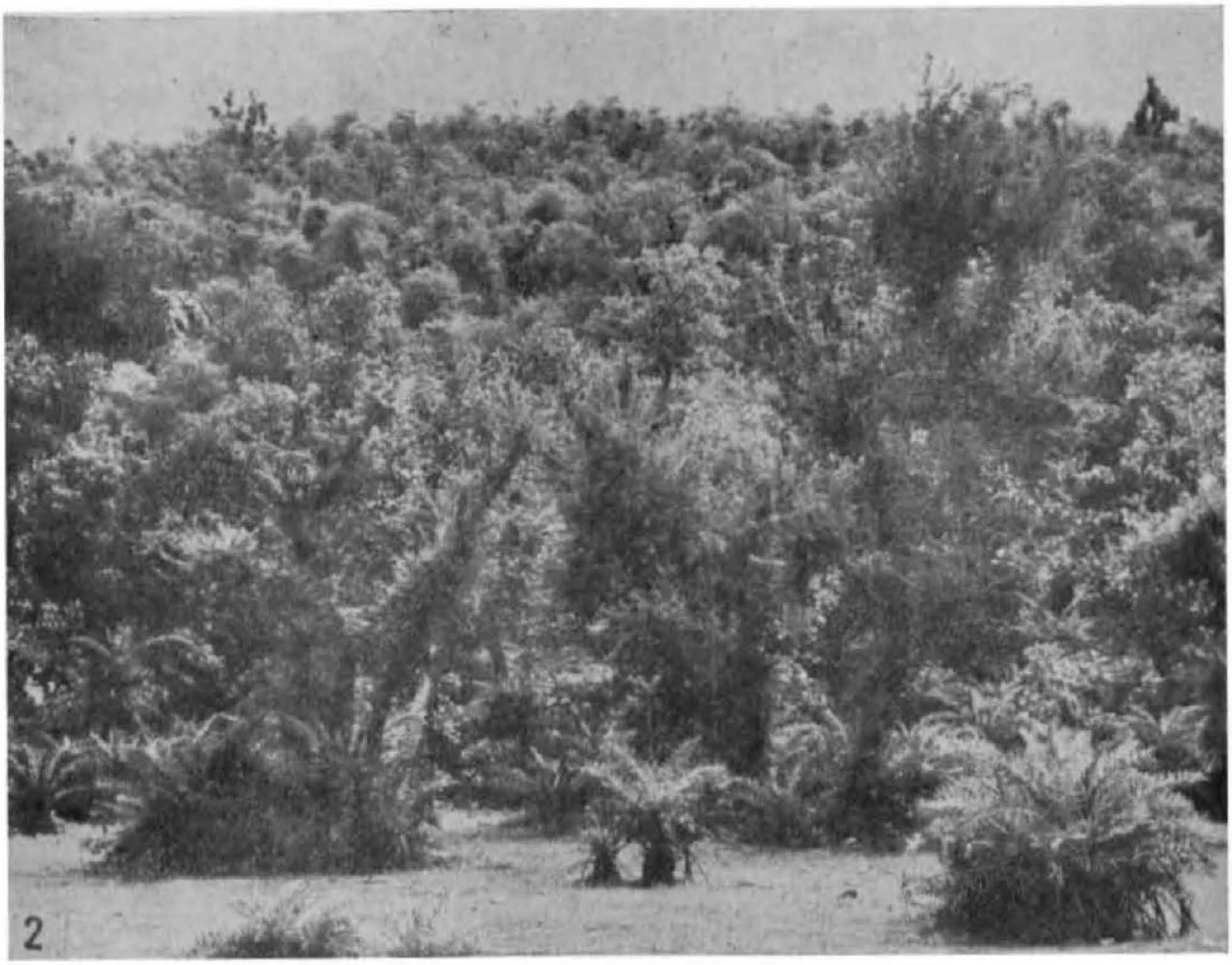

Plate 2: Mixed dry deciduous forest on the hills near Dhaneshwar Mahadev temple, dominated by *Anogeissus pendula* Edgew. At the foot of the hills *Acacia leucophloea* (Roxb.) Willd., *Butea monosperma* (Lam.) Taub., *Phoenix sylvestris* (L.) Roxb., ete. are found.

(ii) *Phoenix sylvestris - Acacia leucophloea.*

(iii) *Acacia nilotica - A. leucophloea.*

At certain places, particularly in somewhat low-lands, pure communities of *Acacia nilotica* (L.) Del. and *Phoenix sylvestris* (L.) Roxb. were also noted. In the protected forests, maintained by the forest department, *Acacia chundra* (Roxb.) Willd., *A. leucophloea* (Roxb.) Willd., *A. nilotica* (L.) Del., *Anogeissus pendula* Edgew., *Bauhinia racemosa* Lam., *Butea monosperma* (Lam.) Taub., etc. grow in the same association. The exotic weed *Parthenium hysterophorus* L. is commonly met in the protected forests.

The tectonic plains are quite favourable for shrubs and undershrubs which form a comparatively dense layer in this area (Plate-3). The most common shrubs growing in clumps with trees and in vacant spaces are: *Abutilon indicum* (L.) Sweet, *Adhatoda zeylanica* Medic., *Annona squamosa* L., *Calotropis procera* (Ait.) R. Br., *Capparis sepiaria* L., *Clerodendrum phlomidis* L. f., *Dichrostachys cinerea* (L.) Wt. & Arn., *Grewia flavescens* Juss., *Kirganelia reticulata* Baill., *Lantana camara* L., *L. indica* Roxb., *Leptadenia pyrotechnica* (Forsk.) Decne., *Mimosa hamata* Willd., *Opuntia elatior* Mill., *Solanum incanum* L. and *Ziziphus nummularia* (Burm. f.) Wt. &

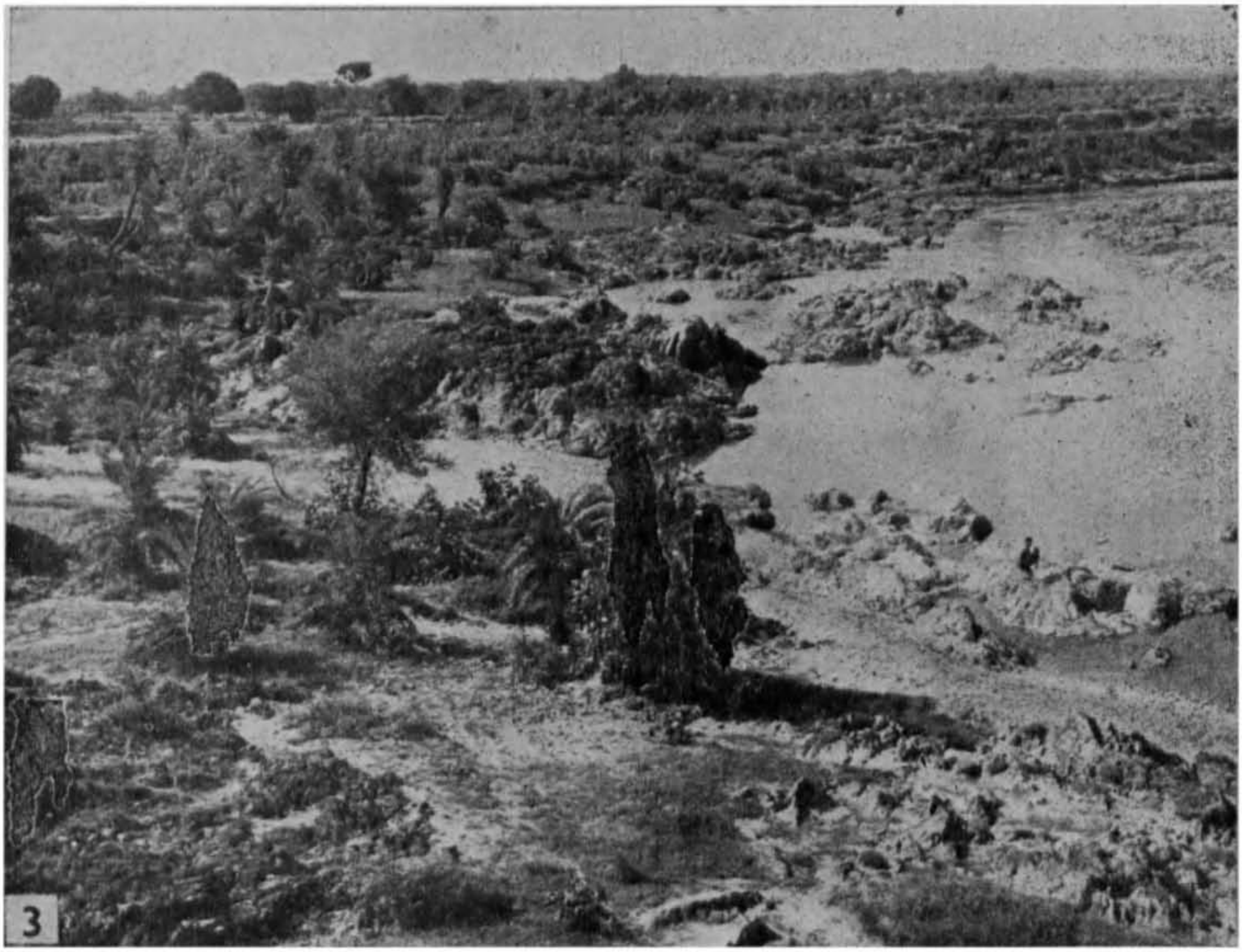

Plate 3 : Ravines along the river Beach near Sagwaria village showing the characteristic vegetation consisting mainly of *Butea monosperma* (Lam.) Taub. and *Phoenix sylvestris* (L.) Roxb.

Arn. which is very gregarious at certain places. Besides these, browsed stunted plants of *Anogeissus pendula* Edgew. and *Balanites aegyptiaca* (L.) Del. are also abundant.

A large number of undershrubs are also met within the plains ; the most common ones are: *Hibiscus caesius* Garcke, *H. ovalifolius* (Forsk.) Vahl, *Melhania futteyporensis* Munro ex Mast., *Pupalia lappacea* (L.) Juss., *Sida ovata* Forsk., *Triumfetta rotundifolia* Lam.. *Xanthium strumarium* L., etc. There are no epiphytes in this area ; however, some climbers like *Cayratia trifolia* (L.) Domin, *Dioscorea bulbifera* L., *Gloriosa superba* L., *Holostemma annulare* (Roxb.) K. Schum., *Ipomoea obscura* (L.) Ker-Gawl., *Leptadenia reticulata* (Retz.) Wt. & Arn., *Marsdenia tenacissima* (Roxb.) Moon, *Momordica dioica* Roxb., *Pergularia daemia* (Forsk.) Chiov., *Rhynchosia minima* (L.) DC., *Rivea hypocrateriformis* (Desv.) Choisy, *Wattakaka volubilis* (L. f.) Stapf, etc. grow among the shrubs and bushes.

A large number of annuals and perennials ranging from psammophytic and semi-xerophytic to aquatic and amphibious herbs or herbaceous climbers are encountered in the plains which give glorious appearance during the rainy season. The life cycle of most of these herbs comes to a close before winter sets in. The common ephemeral herbs are: *Acalypha ciliata* Forsk., *Aerva lanata* (L.) Juss., *Ageratum conyzoides* L., *Alysicarpus monilifer* (L.) DC., *Amaran-*

thus spinosus L., *A. tricolor* L., *A. viridis* L., *Andrographis echioides* Nees, *Anisomeles indica* (L.) Ktze., *Argemone mexicana* L., *Aristolochia bracteolata* Lam., *Blumea obliqua* (L.) Druce, *Boerhavia diffusa* L., *Borreria articularis* (L. f.) F. N. Will., *Cardiospermum halicacabum* L., *Cassia pumila* Lam., *C. tora* L., *Cleome viscosa* L., *Commelina benghalensis* L., *Convolvulus microphyllus* Sieb. ex Spreng., *Corchorus olitorius* L., *C. trilocularis* L., *Crotalaria medicaginea* Lam., *Cucumis melo* L. var. *culta* Kurz, *Cyperus niveus* Retz., *Echinops echinatus* Roxb., *Elytraria acaulis* (L. f.) Lindau, *Euphorbia geniculata* Orteg., *E. hirta* L., *E. thymifolia* L., *Glossocardia bosvallea* (L. f.) DC., *Goniogyna hirta* (Willd.) Ali, *Indigofera cordifolia* Heyne ex Roth, *I. linifolia* (L.) Retz., *I. linnaei* Ali, *I. tinctoria* L., *I. tirta* L. f., *Leucas cephalotes* (Roth) Spreng., *Malvastrum coromondelianum* (L.) Garcke, *Martynia annua* L., *Ocimum americanum* L., *Oxalis corniculata* L., *Polygala arvensis* Willd., *P. erioptera* DC., *Salvia aegyptiaca* L., *Solanum surattense* Burm. f., *Tephrosia purpurea* (L.) Pers., *Trianthema portulacastrum* L., *Tribulus terrestris* L., *Vicoa indica* (L.) DC., and several grasses which fall under two main categories. The grasses of the first category are tall and can be seen in the protected forests in the tectonic plains. The common species are: *Alloteropsis cimicina* (L.) Stapf, *Bothriochloa pertusa* (L.) Camus, *Cenchrus ciliaris* L., *Chloris virgata* Sw., *Chrysopogon fulvus* (Spreng.) Chiov., *Desmostachya bipinnata* (L.) Stapf, *Dichanthium annulatum* (Forsk.) Stapf, *Digitaria adscendens* (H. B. & K.) Henr., *Dinebra retroflexa* (Vahl) Panz., *Eleusine indica* (L.) Gaertn., *Eragrostiella bifaria* (Vahl) Bor, *Eragrostis ciliaris* (L.) R. Br., *E. diarrhena* (Schult.) Steud., *E. japonica* (Thunb.) Trin., *E. tremula* Hochst. ex Steud., *Eremopogon foveolatus* (Del.) Stapf, *Heteropogon contortus* (L.) P. Beauv. ex Roem. & Schult., *Iseilema laxum* Hack., *Setaria tomentosa* (Roxb.) Kunth, *Sporobolus diander* (Retz.) P. Beauv., etc. The grasses of the second category grow in the open tectonic plains. They are mostly palatable and comparatively shorter or almost prostrate. The common ones are: *Aristida adscensionis* L., *Brachiaria ramosa* (L.) Stapf, *Cenchrus setigerus* Vahl, *Cynodon dactylon* (L.) Pers., *Dactyloctenium aegyptium* (L.) P. Beauv., *D. aristatum* Link, *Melanocenchris jacquemontii* Jaub. & Spach., *Oropetium thomaeum* (L. f.) Trin., *Tragus roxburghii* Panig., *Tripogon jacquemontii* Stapf, etc. *Ipomoea eriocarpa* R. Br. and *I. pestigridis* L. are the common weeds among the grasses. In the ravines along the rivers and their tributaries *Butea monosperma* (Lam.) Taub., *Phoenix sylvestris* (L.) Roxb. and *Vitex negundo* L. are more common.

Datura innoxia Mill., *Pedalium murex* L., *Physalis peruviana* L. and *Ricinus communis* L. are common near habitations. *Setaria pallide-fusca* (Schum.) Stapf ex Hubb. and *S. tomentosa* (Roxb.) Kunth are common during rainy season among the fences made along the houses. In the drying ponds along the roads *Heliotropium ovalifolium* Forsk. and *Hygrophila auriculata* (Schum.) Heine are abundant, while *Panicum antidotale* Retz. is met with in wastelands near the ponds.

(3) *Aquatic and marshland habitats*: The area maintains variable habitats for the growth of aquatic and marshland plants. The rivers like Wagon and Berach and their tributaries are characterised by their rocky bottom and banks and, hence, the hydrophytes grow only where considerable amount of sand accumulates. *Crinum defixum* Ker-Gawl. is the main hydrophyte growing in rocky ground in the rivers. The artificial tanks, which are used for irrigation, are under great biotic pressure and maintain a very sparse vegetation. However, the natural deep water tanks, ponds,

low-lying areas, etc. present a variable emporium for many aquatic and amphibious plants, particularly in Bhadesar tehsil area. The common aquatic and marshland species are: *Alternanthera sessilis* (L.) DC., *Ammannia baccifera* L., *Bacopa monnieri* (L.) Pennell, *Colocasia esculenta* (L.) Schott, *Cyperus difformis* L., *C. iria* L., *C. nutans* Vahl, *C. pangorei* Rottb., *C. pygmaeus* Rottb., *Dentella repens* (L.) Forst., *Echinochloa colonum* (L.) Link, *E. crusgalli* (L.) P. Beauv., *Eclipta alba* (L.) Hassk., *Eleocharis dulcis* (Burm. f.) Henschel, *Fimbristylis complanata* (Retz.) Link, *F. dichotoma* (L.) Vahl, *F. ovata* (Burm. f.) Kern, *Hemiadelphis polysperma* (Roxb.) Nees, *Hydrilla verticillata* (L. f.) Royle, *Ipomoea aquatica* Forsk., *Mimulus strictus* Benth., *Monochoria hastata* (L.) Solms, *Najas minor* All., *Nymphaea nouchali* Burm. f., *N. pubescens* Willd., *Nymphoides cristatum* (Roxb.) Ktze., *Paspalidium flavidum* (Retz.) A. Camus, *Paspalum paspaloides* (Michaux) Schribner, *Phyla nodiflora* (L.) Greene, *Polygonum glabrum* Willd., *Potamogeton pectinatus* L., *Pycreus flavidus* (Retz.) T. Koyama, *Scirpus supinus* L., *Trapa bispinosa* Roxb., *Typha angustata* Bory & Chaub., *Vallisneria spiralis* L., *Vetiveria zizanioides* (L.) Nash, etc. These species grow in different associations.

Some species form pure stands like *Colocasia esculenta* (L.) Schott, *Pandanus odoratissimus* L. f. and *Monochoria hastata* (L.) Solms. The paucity of aquatic species may be due to the rocky bottom and wide amplitude of water level in reservoirs. *Phoenix sylvestrirs* (L.) Roxb., *Imperata cylindrica* (L.) P. Beauv. and *Hemarthria compressa* (L. f.) R. Br. are common in low-lying areas (Plate-4).

(4) *Crops and weeds*: Two main crops *viz.* Rabi and Khariff are grown on commercial scale. The principal Khariff crops are Maize, Jowar, Cotton, Pulses, Ground nut and Sugarcane. Rabi crops include Wheat, Barley, Gram, Oil seeds, Methi, Ulsi, Dhania and Opium. In Rabi crops, during the winter season, the common weeds are: *Anagallis arvensis* L., *Asphodelus tenuifolius* Cav., *Chenopodium album* L., *Euphorbia dracunculoides* Lam., *Fumaria indica* (Haussk.) Pugsley, *Lathyrus aphaca* L., *Lepidium sativum* L., *Medicago polymorpha* L., *Melilotus alba* Medik., *M. indicus* L., *Spergula arvensis* L., *Vicia hirsuta* (L.) S. F. Gray, etc. During the rainy season, *Chenopodium murale* L., *Commelina forskalaei* Vahl, *Corchorus olitorius* L., *C. trilocularis* L., *Cyanotis cristata* (L.) D. Don, *Cyperus rotundus* L., *C. triceps* (Rottb.) Endl., *Digera muricata* (L.) Mart., *Launaea procumbens* (Roxb.) Ramayya and Rajagopal, *Murdannia nudiflora* (L.) Brenan, *Phyllanthus maderaspatensis* L., *Rostellularia prostrata* (Cl.) Majumdar, *R. quinqueangularis* (Koen. ex Roxb.) Nees, *Solanum nigrum* L., *Trianthema portulacastrum* L., *Tribulus terrestris* L., *Vicoa indica* (L.) DC. and the species growing in the nearby wastelands compete with the Khariff crops as weed.

(5) *Plantations*: On the boundaries of the fields *Euphorbia neriifolia* L., *E. nivulia* Buch.-Ham., *Jatropha curcas* L., etc. have been planted. The climbers growing in the tectonic plains are comparatively more abundant along the boundaries of the fields e.g. *Basella alba* L., *Blastania garcini* (L.) Cogn., *Clitoria ternatea* L., *Coccinia grandis* (L.) Voigt, *Luffa acutangula* Roxb., *Mukia maderaspatana* (L.) Roem., *Pueraria tuberosa* DC., *Trichosanthes bracteata* (Lam.) Voigt and *T cucumerina* L.

Ailanthus excelsa Roxb., *Albizia lebbeck* (L.) Benth., *Azadiracta indica* Juss., *Dalbergia sissoo* Roxb., *Ficus benghalensis* L., *F. religiosa* L., *Holoptelea integrifolia* (Roxb.) Planch., *Mangifera indica* L., *Tamarindus indica* L. *Ziziphus mauritiana* Lam., etc. are usually planted as avenue trees, particularly along the roads.

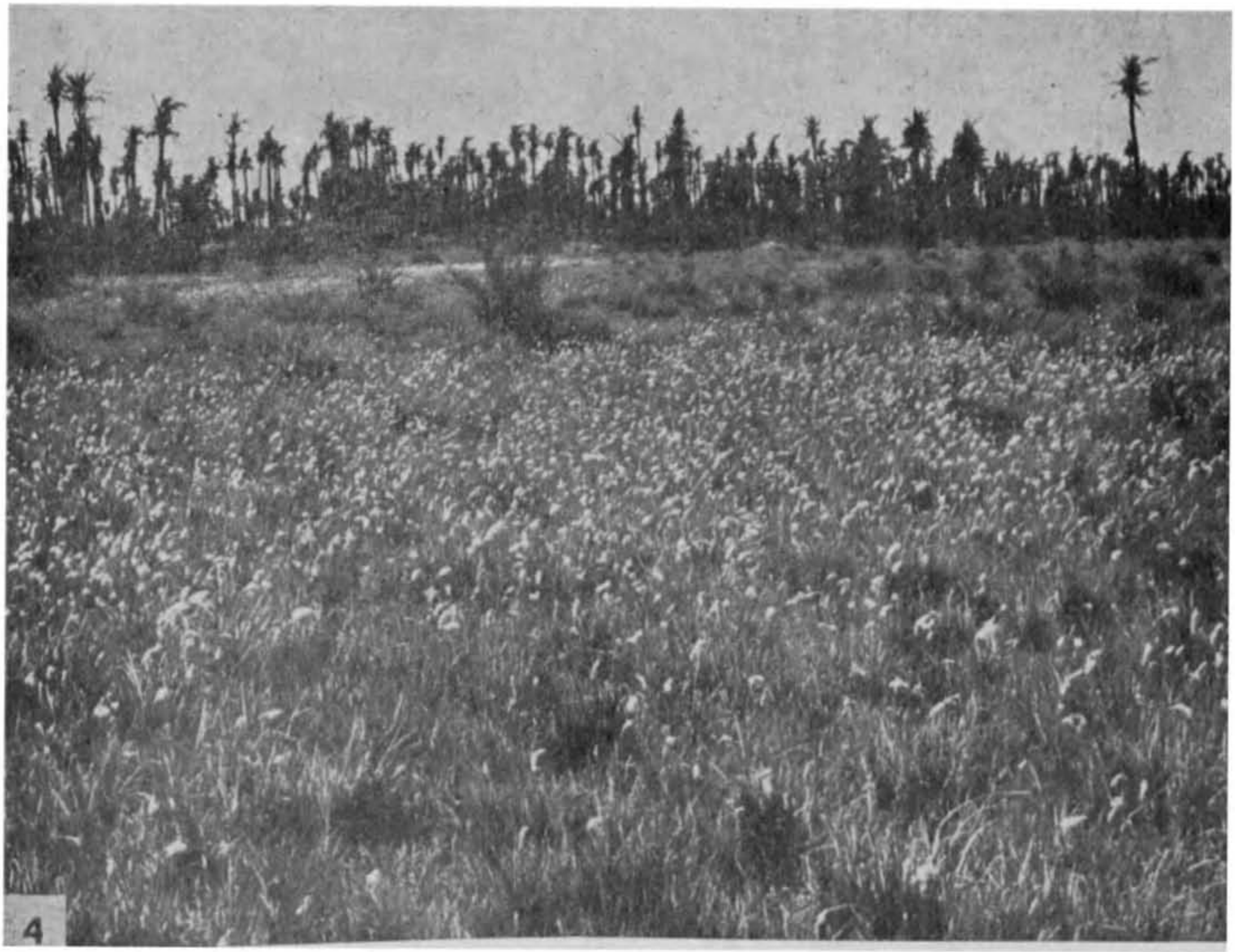

Plate 4: Lowlands near Dhirji-ka-khera village, with *Phoenix sylvestris* (L.) Roxb. and *Imperata cylindrica* (L.) P. Beauv.

CONCLUSIONS

The floristic composition of the catchment and submergence area suggests semi-arid climate due to the presence of abundant ground cover during rainy season, mixed deciduous forests, distantly scattered deciduous trees and comparatively dense growth of xerophytic shrubs in the tectonic and undulating plains. The floristic analysis of the flora is as under:

	Dicotyledons		*Monocotyledons*		*Pteridophytes*		*Grand total*
	No.	*% of total*	*No.*	*% of total*	*No.*	*% of total*	
Families	61	79.2	14	18.2	2	2.6	77
Genera	179	75.53	56	23.63	2	0.84	237
Species	200	72.5	73	26.4	3	1.1	276

The floristic analysis shows that monocots (73 species) are poorly represented in the area, and among the dicots, Polypetalae is more abundant (90 species) in comparison to Gamopetalae (77 species) and Monochlamydeae (33 species). A comparative study of the vegetation of this area with the rest of the district revealed that it is almost similar due to identical topography, soil, geology, seapage, silting, physio-chemical properties of water, substratum, climate and biotic factors. There are no endangered, vulnerable, threatened and endemic taxa in this area.

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